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Energy Source: Plastic Waste into Fuel

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ABSTRACT

The increasing high price and demand for energy source drive our effort to convert solid waste into useful fuel. An eco friendly energy is retrieved from waste plastic materials through automated waste management system and it is tested successfully with the help of arduino board. A simple pyrolysis decomposition method is modified into a hybrid method for power generation. A new hybrid pyrolysis method gives good yield than other productions, and the recovered sample is characterized with the help of Fourier transform infrared spectroscopy (FTIR).

Keywords: Pyrolysis decomposition, Plastic waste into fuel, automated waste management system.

1. INTRODUCTION

The environmental issues were reduced only with the development of technology [5, 6, 14] people use technologies for an easy way of using more and more consumer goods to get comfortable life as well as theoretical issues to be rectified [7-13], and in the recent years, we have been using plastic to make our work easy and consume things. This easy way leads to huge amount of plastic wastages. So, we are looking for methods to manage waste products especially plastic wastages. Manly laboratories in the world are searing for methods to minimize the wastages and methods to make use of wastages. One among such methods is newly modified with pyrolysis setup to boost the efficiency of the fuel obtained from waste plastic materials. Plastic wastages were used in this set up to derive fuel. A fully automated waste management system was constructed and the temperature was controlled with the help of arduino board. The final fuel yield was achieved as 65ml from 250g of plastic waste; which is higher than the yields obtained in the other reports [1-4]. These findings are reported in this article.

2. EXPERIMENTAL SETUP DESIGN AND METHOD

Design

The external appearance of modified hybrid pyrolysis method is shown in the figure 1. It consists of a cylinder length 147 cm with diameter 39cm; the outlet of the cylinder is sealed with one end and the other end is connected with automated waste management system having arduino board. The semi batch portion of the setup is made up Fe and Cr: Al –K type thermocouple is used which is manufactured by Prajapati Industries, Mumbai. The temperature is controlled with the help of PID controller, which is jointly connected with arduino board for better accuracy.

Figure 1 Modified hybrid pyrolysis setup

Figure 2 liquid fuel

Method

250g Plastic slurries are mixed with 2.5 ml of Acetone for cleaning process and those plastic slurries were loaded in pyrolysis setup. The reactions were carried out in between 400℃ and 420℃ under atmospheric pressure and plastic slurries and high density poly ethylene polymer are taken in the ratio 5:2. The output of the liquid fuel is automatically collected from the branched tube of the setup. The yield of this setup achieved as 65ml fuel and the solid residue was disposed. A pale yellow transparent liquid fuel obtained without wax is shown in figure 2.

3. RESULT AND DISCUSSION

Temperature Effect on Product distribution

The condensable and non-condensable reaction contributes more solid residues. The condensable oil/wax distribution range is shown in the figure 3. The good condensable product was achieved at 420℃; which is higher than the one presented in [3]. The volatiles fraction (non-condensable) for 400℃, 405℃, 415℃, and 420℃ results 84.3, 84.5, 86.6, and 87.7 wt.% respectively. This result is agreed well with literature report [2].

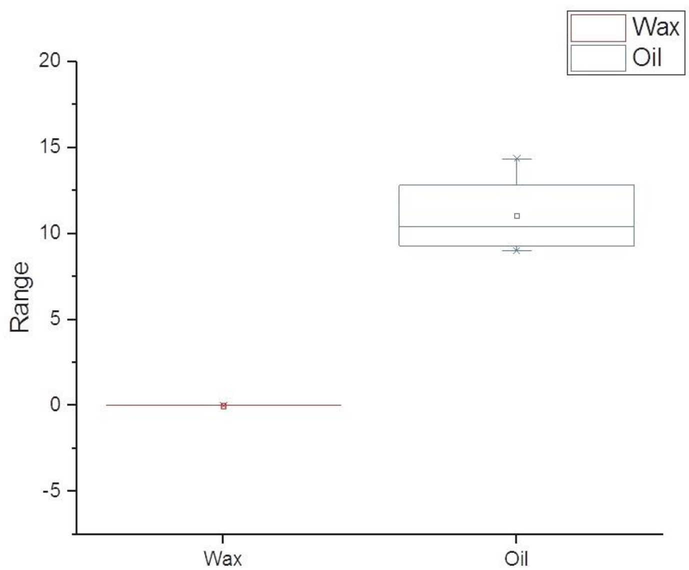

Figure 3 Condensable distribution range

Temperature Effect on Reaction Time

The pyrolysis reaction rate depends on high density polyethylene ratio with respect to time and temperature is shown in the figure 4. The high strength and long linear polymer require more time for decomposition. Thus, the condensable and non-condensable reaction agreed with the reaction time and shows the yield of the wax, liquid fuel and gas.

FTIR Analysis

The FTIR is used to know the sample functional group. The Figure 5 shows the FTIR result for liquid fuel. The wavenumber of 2936 cm^{-1} and 2796 cm^{-1} shows C-H functional group with stretching vibration. The wavenumber of 1652 cm^{-1} shows C=H group present

in the sample and the bending nature of C-H and the out of plane bending vibration of C-H wavenumber peaks occur at 1101 cm^{-1} and 960 cm^{-1} respectively. Similarly, the C-H functional groups are also present in the wavenumber range of 792 cm^{-1}.

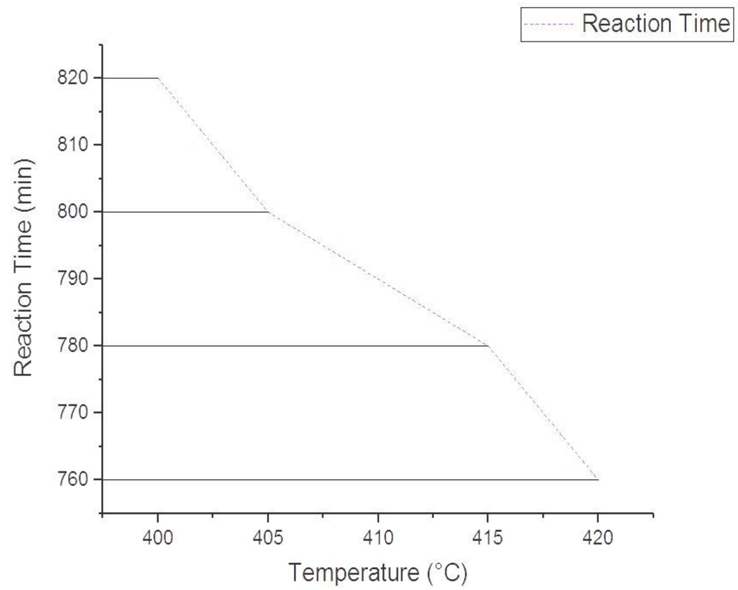

Figure 4 Effect of Temperature on Reaction time

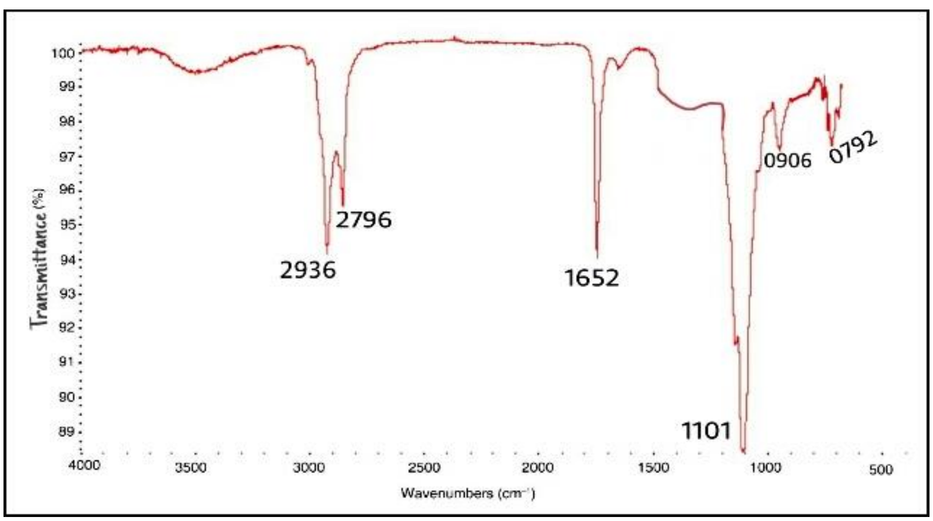

Figure 5 FTIR for Liquid fuel

4. CONCLUSION

A modified pyrolysis method is developed newly to recover liquid fuel from plastic waste. The 65ml of liquid fuel is obtained at 420℃ from 250 g of plastics and the fuel functional group was analyzed with the help of FTIR.

Supplementary

Program for Arduino - Automated Waste Management System

```
#include <Servo.h>

Servo myservo;
Servo myservo1;
```

```
constintcnv=3;
constint cnv2=4;
constint cm=5;
constintpmp=12;
constint pmp2=13
;

intpos = 0;    // variable to store the servo position

void setup() {
pinMode(cnv, OUTPUT);
pinMode(cnv2,OUTPUT);
pinMode(pmp, OUTPUT);
pinMode(pmp2,OUTPUT);
myservo.attach(10);
myservo1.attach(9);
pinMode(cm, OUTPUT);
}

void loop()
{

digitalWrite(cnv,HIGH);
pos=180;
myservo.write(pos);
myservo1.write(0);
delay(7000);
digitalWrite(cnv,LOW);
delay(700);
myservo1.write(90);
digitalWrite(cm,HIGH);
digitalWrite(pmp2,HIGH);
delay(7000);
myservo1.write(0);
digitalWrite(cm,LOW);
digitalWrite(pmp2,LOW);
delay(700);
delay(700);
digitalWrite(cnv2,HIGH);
digitalWrite(pmp2,HIGH);
pos=0;
myservo.write(pos);
delay(6000);
pos=180;
myservo.write(pos);
delay(19000);
digitalWrite(cnv2,LOW);
digitalWrite(pmp2,LOW);
delay(19000);
}
```

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